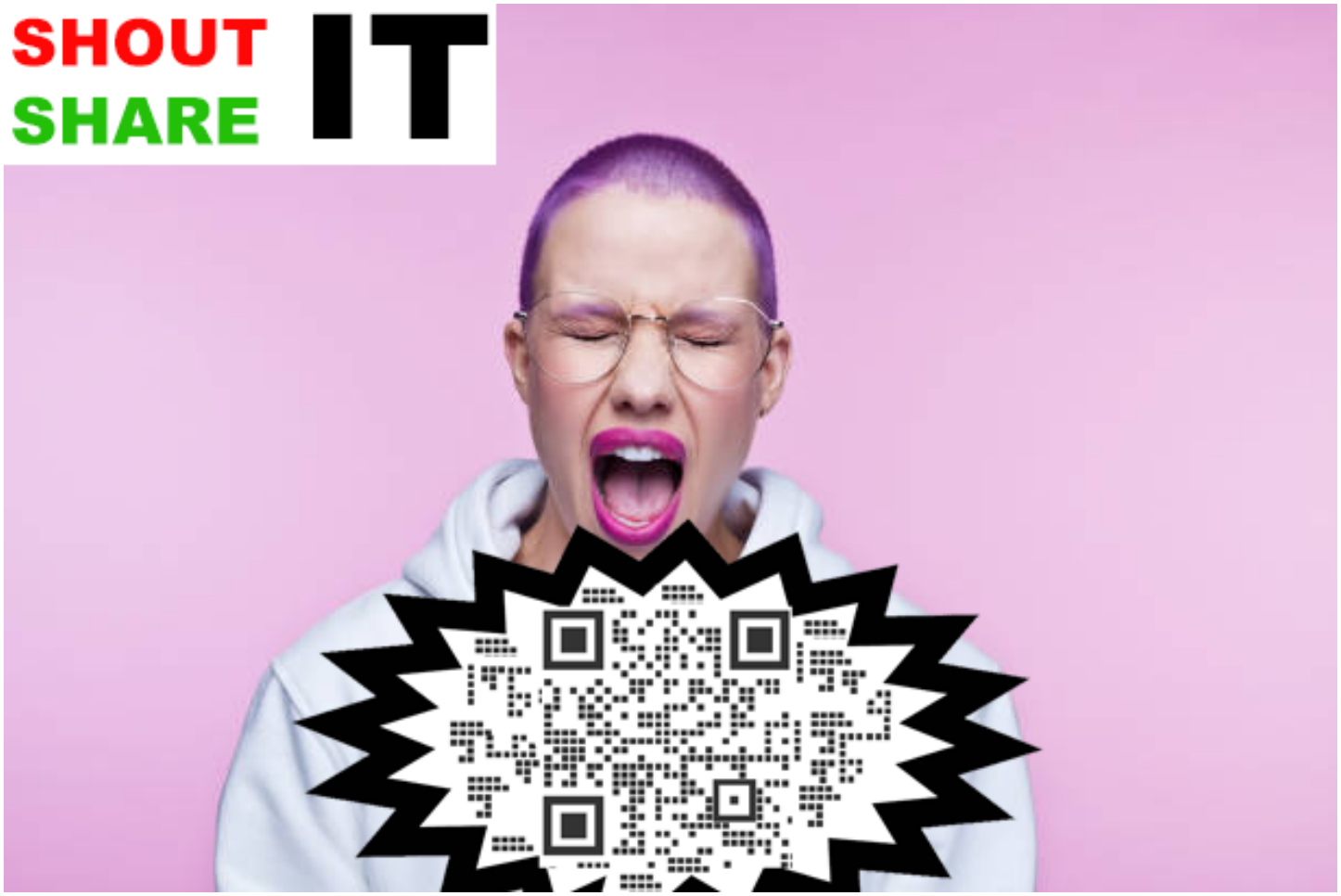
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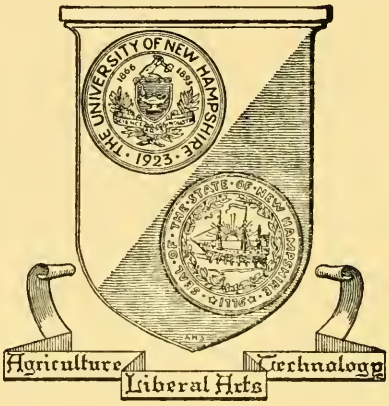

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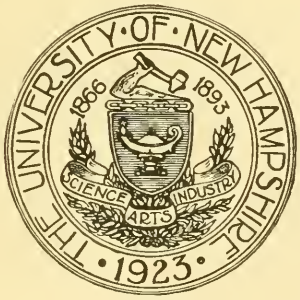
Bulletin No. 221 February, 1926

NEW HAMPSHIRE

AGRICULTURAL EXPERIMENT STATION

PROGRESS OF AGRICULTURAL EXPERIMENTS—1925

A REPORT OF THE DIRECTOR OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION FOR THE YEAR 1925, INCLUDING A FINANCIAL STATEMENT FOR THE FISCAL YEAR ENDING JUNE 30, 1925



THE UNIVERSITY OF NEW HAMPSHIRE

DURHAM, N. H.

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THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

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PROGRESS OF AGRICULTURAL EXPERIMENTS, 1925

ANNUAL REPORT OF THE DIRECTOR OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

For the Year 1925

The past year has been a notable one in the Experiment Station's history. At almost the same time that the State Legislature was providing a permanent foundation for the University as a whole through the passage of the Mill Tax Bill, the Federal Congress made possible a broadening and an expansion of agricultural research through the passage of the Purnell Act.

The main object of the increased federal appropriation was to enable the various states to expand their investigations, particularly in the fields of agricultural economics, home economics, and rural sociology. In New Hampshire the accumulation of the most pressing needs for research work will in the main, it is hoped, be satisfied by the new fund.

A complete copy of the Purnell bill will be found in a supplement to this report. This act "for the more complete endowment of agricultural experiment stations," which was passed by the House of Representatives February 10, 1925, went into effect July 1 of this year. It provides for "paying the necessary expenses of conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products, and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life, and for printing and disseminating the results of said researches."

The act appropriates $20,000 for the present fiscal year with annual increments of $10,000 until the total is reached of $60,000 per year, making the total federal contribution to the station (including the Hatch and Adams funds) $90,000 annually.

As a result of this appropriation, it has already been possible to start work in nine new projects in New Hampshire during the present year.

1. *Agricultural Economics.* For many years there has been an acute need for marketing investigations in the state. Hitherto under the funds available, it has been possible to deal only with problems of production. We have had no basic facts on which to build the marketing campaign which has been cried for in many quarters. It has seemed that a first step should be to make a thoroughgoing investigation of the economic balance between the production and consumption of those products which can successfully be grown within the borders of the state.

How much money is leaving the state for foodstuffs which can be grown here? Are we in a position to compete successfully with other states in such production? Upon the answer to these questions much of our agricultural future hangs.

The object of the economic study which we are undertaking is to ascertain the consumption demand within the state of those products

that are, or well may be, grown in New Hampshire with reasonable expectation of profit; to determine to what extent the present farm production is meeting that demand; and to study the factors involved in the readjustment of the production of certain commodities, and better land utilization.

A study of the railroad receipts and shipments of hay, potatoes, fruit, most of the vegetables, and poultry and dairy products is being made and is supplemented by estimates from retailers as to the quantity of products handled. An analysis of local production of these products is also being made, and we are planning to study the grade, quality, packing, and methods of distribution of locally grown products as compared with those shipped in from other areas.

2. *Apple Marketing Study.* The marketing problems of New Hampshire are, of course, inextricably entwined with those of New England as a whole. With this fact in mind we are co-operating with the other New England states through the New England Research Council on Marketing and Food Supply in the first of what it is hoped will be a series of commodity studies. The apple industry was selected for this purpose, and a uniform plan of securing data from the commercial orchards of this area has been followed. Personal visits have been made to practically 100 per cent, it is believed, of the commercial orchards of the state, and detailed records have been taken showing the production and plantings by varieties, methods of marketing, and other pertinent facts. A report of this investigation will probably be made within the coming year.

3. *Soil Study.* The problem of the run-out hay land of the state is another question of fundamental importance to our agriculture. One of the first steps under the Purnell Act has been to establish experiments that will run over a period of years to determine the effect of certain cultural practices and treatments on neglected hay lands, and to study the chemical composition of the soil used. Three immediate experiments have been decided upon to throw light on this problem: one with grass, one with legumes, and one with rotations.

One of the difficulties in the past which has prevented successful work along this line has been the lack of any typical soil on the college farm that was either sufficiently worn out or sufficiently uniform. For this reason it has been decided to locate these experiments in other parts of the state. After a considerable amount of search for suitable locations, a field has been found in Greenland where there have already been started the grass and legume experiments.

4. *Dairy Nutrition.* The long-time studies of nutrition, which are being conducted in connection with the Carnegie Institute of Washington, have dealt principally with steers. The results of this work have been such as to justify its expansion into the more complex problem of the nutrition of dairy cows, particularly since it has been found possible to enlarge our facilities materially without greatly expanding our "overhead charges." The object of the new work will be to study the basal energy metabolism as affected by different planes of nutrition, the effect of environmental temperature, some of the physiological activities in relation to varying feed levels, and other important factors.

This work will be carried on more or less continuously with two animals subject to laboratory control. As a supplement to it, arrangements have also been made with the Dairy Department for a physiological study of

cows kept under conditions of practical herd management, such cows to represent four different breeds. This work is already well under way.

5. *Other Studies.* Among other important studies which have been made possible under this fund are: (1) a study of the white pine weevil which is one of the most serious of our forest pests; (2) an expansion of the study of the effect of place on mosaic and leaf-roll, the diseases which, it has been proved, have caused our potato stock to degenerate seriously; and (3) the investigation of one of the important problems of ice-cream manufacturing.

These studies are only a beginning of the work which has been planned under the Purnell Fund. We are hoping within the next year to start work along some of the other pressing lines on which little research data are available.

Electricity and Agriculture

Another important advance made during the year was the beginning of a study of the relation of electricity to agriculture in New Hampshire. This project, which is to last for a period of at least three years, was undertaken in co-operation with the New Hampshire Committee on the Relation of Electricity to Agriculture at the suggestion of the National Committee, which desired to carry on experimental work for the New England area as a whole, and which selected the New Hampshire Station for the co-operative work in this region. A more detailed review of the subject will be found later in this report. The work is financed by the state committee in co-operation with power and utilities companies, which are members of the New England Division of the National Electric Light Association.

Need of State Funds

This electrical project is an example of work which is of the most acute importance to the agriculture of the state but which is of the type that cannot be financed under federal funds. In this particular case it has been possible for work to be supported by co-operating agencies. In most of the lines of state service, however, this is not practicable. Examples of such state service work are: the testing of soil samples; tests of samples for individual farmers of feedstuffs, fertilizers, and seeds; field variety tests; drainage service work; tests of strains of certified seed; assistance to milk plants and creameries; identification of insect pests and plant diseases; tests of varieties of fruits and vegetables; service work in connection with orchards, small fruits, etc.; the handling of a great deal of state correspondence; the development and backing up of our extension program with conferences, publicity, and speaking engagements. It is obvious that this work is purely of state importance, and should be supported by state rather than federal funds.

It is interesting to note that in most of the states of the country, state appropriations are more than sufficient to cover such matters. In fact, the direct appropriations from the various states for the fiscal year 1924 aggregated $6,000,000,—more than four times the amount of federal appropriations. Even upon the maturity of the Purnell Fund, the amount of federal appropriations would be hardly more than half of the above-named aggregate of state funds.

The following paragraph is quoted from page 7 of Bulletin 13 of the

Association of Land-Grant Colleges. April, 1925, "Report of Special Meeting of Presidents and Station Directors dealing with the Purnell Act":

One point stressed by the Chairman of the Executive Committee and emphasized by the Secretary of Agriculture in his address was to the effect that the Purnell monies were appropriated, in the language of the act, "in addition to the amounts now received"; that the clear intent of Congress, expressed in hearings and on the floor during discussion, was to increase the ability of the Stations to do work in behalf of the public welfare; that in no sense was this appropriation meant to be in lieu of a state appropriation; that the federal allotment does not relieve the states of their responsibilities in the matter of Station support.

For these reasons it seems essential that the state should at least continue the amount of support already given the Experiment Station, either through the regular appropriations to the University as a part of the Mill Tax Fund, or as a special appropriation.

Changes in Personnel

During the past year, the following changes in personnel have taken place: Dr. T. G. Phillips, formerly of Ohio State University, has been appointed chemist, taking the place left vacant by the resignation of Dr. H. R. Kraybill. Mr. Ford S. Prince, who was several years ago a member of the station staff, has been appointed specialist in soils and crops. Mr. W. T. Ackerman, formerly of the Iowa State Agricultural College, has been appointed leader in the rural electricity project. Mr. L. B. Lincoln has been secured to assist in the state-wide economic survey. Mr. Fred R. Clark has been appointed assistant botanist to take the place of Dr. L. J. Klotz. Mr. A. W. Petre has been appointed graduate assistant in the agricultural chemistry department. Mr. R. D. Stevens has been appointed assistant forester. Mr. M. H. Voyagis has been appointed assistant in the animal husbandry department.

Improvements

A much needed improvement has been made in our library and mailing facilities by concentrating each in separate rooms. This has relieved serious congestion in the central office and made possible a more efficient operation of extension and station machines and clerical work.

Publications

The following publications have been issued during the year:

Station Bulletin No. 213—Inspection of Commercial Feeding Stuffs for 1924.
Station Bulletin No. 214—Inspection of Commercial Fertilizers for 1924.
Station Bulletin No. 215—Results of Seed Tests for 1924.
Station Bulletin No. 216—Progress of Agricultural Experiments. 1924.
Station Bulletin No. 217—The Balance Between Farm Production and Market Demands in Cheshire County, New Hampshire.
Station Circular No. 24—Effect of Spray Pressure and Number of Nozzles on Late Blight of Potatoes.
Station Circular No. 25—Control of Apple Scab.
Technical Bulletin No. 28—Effect of Phosphorus on Yield and Time of Maturity of the Tomato.

REPORT BY PROJECTS

ANIMAL HUSBANDRY

Sheep Breeding—(*Adams Fund*)

The three distinct groups of sheep of which the Station flock is composed, as reported last year, are still being bred separately. The object for the present is to continue selection within each group so as to develop the individual characteristics or merits of each group before attempting to merge them. The work is in charge of E. G. Ritzman.

The Southdown x Rambouillet group, which is now in its fourth generation of breeding, appears to transmit those characteristics for which it has been selected and bred with as much stability as any of the standard breeds. These are primarily in traits of conformation and character of wool.

The Rambouillet x Oxford cross has reached only the first generation of offspring, and it is in the second generation where rigid culling will be applied on a basis of milk yield and of fecundity.

The Bell flock, or multi-nippled sheep, are also being culled for developing a high milk yield, primarily, however, on the basis of four nipples of equal functional capacity.

Since the final objectives are (1) high fecundity, (2) good weight of lambs for slaughter at a relatively early age, and (3) good fleece in the breeding flock as a whole, these traits in the offspring of the three groups may be summarized as in Table I.

TABLE I—*Traits in offspring of sheep crosses* *

	Fecundity	Weight of lambs at 3½ months		Fleece weight	Characters, grade	Number of nipples
		Live	Dressed			
	Per cent	Lbs.	Lbs.	Lbs.		
Sn x R	170	61	23	8.00	½ staple	2
R x O	182	65	25	9.00	⅜ "	2
Bell flock	127	62	27	7.00	¼ "	4–6

* The figures represent a varying number of animals and are offered only as a general picture of results to date. The results of the Bell flock must be discounted, since they are taken only from 14 animals over a period of two years.

Data accumulated on the inheritance and character traits of wool during the last fifteen years are now in process of preparation for publication as a technical bulletin of the Station series.

Nutrition Studies with Beef Steers (*Adams Fund in coöperation with the Carnegie Institution of Washington*)

The main line of procedure followed in the nutrition project during the past year was a continuation of the study of the influence of environmental temperature on heat metabolism of beef steers. As in the past, the active participation of Dr. F. G. Benedict of the Carnegie Institu-

tion has been of great importance to the success of the work, which has been under the local direction of E. G. Ritzman. Two kinds of rations were used: timothy hay during the earlier part of the experimental season and alfalfa hay during the later stage. Both maintenance and submaintenance rations were fed at different times with both feeds; and, as in previous cases, the temperature of the environment was varied for different experimental periods. The results obtained, particularly as regards the influence of temperature on heat production, are not in any sense final; but tentatively it may be said that this influence was not so great as was expected. Heat production, determined indirectly, was invariably lower on alfalfa than on an equal quantity of timothy hay.

The data obtained in a long series of metabolism experiments with sheep, involving the equivalent of over 1,500 animals and representing stages of age from birth to maturity, are now being prepared for publication.

The results of an exhaustive analytical study by Dr. T. M. Carpenter of the Carnegie Institution of Washington of the urine of steers during fasts of from five to fourteen days, which was carried on under this project, have been published during the year in the proceedings of the National Academy of Sciences. They may be briefly summarized as follows:

Since, when fasting, a steer lives upon its own flesh, and the alkaline urine characteristic of the herbivora changes to the acid urine of the carnivora, a study of the changes in the urine under these conditions throws light upon the changes in the fundamental metabolism as the fast progresses.

The only previous study of the fasting urines of steers with which results may be compared is that made by Grouven, who determined the hippuric acid and ash in the urines of several days, finding a high amount of phosphate.

The total nitrogen indicates that these animals were on a low nitrogen plane as a result of the preceding undernutrition and the ammonia-nitrogen results gave no indications of acidosis.

The urea-nitrogen with both steers was low at first, but rose rapidly to a general level which was slightly increased throughout the fast. Apparently a smaller proportion of the nitrogen is eliminated as urea when the animal is fed than when he is fasting.

The results indicate that hippuric acid may be eliminated even when no food is received, and may be considered as derived from endogenous sources.

The amino-acid nitrogen, which was 18 to 19 per cent of the total nitrogen at beginning, dropped to 1 per cent during the fast.

The preformed and total creatinine had a high degree of uniformity throughout the fast having much the same range as that for the fasting man studied by Benedict.

While the amounts of phenol obtained gradually lowered as the fast progressed, neither the free nor the conjugated phenol entirely disappeared, and presumably there was still undigested residue present with fermentation.

The inorganic sulphate appeared late in the fast, but increased thereafter to the end of the fast. The ethereal sulphate fell gradually but began to rise with the resumption of food. In contrast to values obtained in earlier fasts, both the neutral sulphur and the nitrogen-sulphur ratio were variable, and the percentage distribution of the sulphur varied widely.

Since the fixed bases come from the inorganic elements in the food or body material, the rapid fall to be seen in these values would be expected. The increase in elimination which appeared later in the fast might be interpreted to represent either a diminution in body fluids or a destruction of bone or other organized body material. The organic acids (uncorrected for total creatinine), like the fixed bases, show some fall to a more or less general level after the first few days.

The small change in acetone, diacetic acid, and beta-oxybutyric acid, taken in connection with the values found for ammonia nitrogen, unlike the case with man, indicate that these animals, like the dog and the cat, exhibited no tendency toward ketosis while fasting.

CHEMISTRY

Plant Metabolism Studies (*Adams Fund*)

Analyses of the samples of tomato tissues referred to in the previous report are in progress. It is hoped that these will be completed soon and the results assembled for publication. The work is in charge of T. G. Phillips.

Studies Upon the Lime Requirements of New Hampshire Soils (*State Fund*)

This work has been continued by Dr. Phillips in co-operation with the county agents as in the previous years. During the year, 634 samples of soil have been tested and the results reported to the county agents.

DAIRY CATTLE

Nutrition Studies with Dairy Cows (*Purnell Fund*)

With the coming into effect of the Purnell Act a second project was begun in the nutrition studies but with dairy cows by Messrs. Benedict and Ritzman. A small addition was made to the laboratory building sufficient to supply a feed storage room and to house two cows. Two suitable metabolism stalls have been constructed, and two purebred Holstein cows were purchased for the investigation.

Some time has been spent in devising a mechanical appliance for the continuous separate collection of urine and feces for separate analysis, and it seems very probable that the first year's work will be largely taken up in the perfection of the technique of procedure. As was the case with steers, it is deemed necessary to make first a study of the physiological reactions of these animals to different conditions of feeding, and secondarily to study their maintenance requirements under these conditions.

A material improvement has been made in the technique of respiration experiments in a device for the determination of methane produced by the animals during 24-hour continuous experiments.

Physiological Studies of Dairy Cows (*Purnell Fund*)

This project, which is supplementary to the nutrition studies with dairy cows, aims to make a physiological study of cows kept under conditions of practical herd management. Four dairy breeds—Ayrshire, Guernsey, Jersey, and Holstein—will be used. Among the studies which are to be made by J. M. Fuller in co-operation with Dr. Benedict of the Carnegie Institution, will be pulse rates under varying conditions—such as standing and lying—and studies of urine and feces.

DAIRY PRODUCTS

Study of Some Important Factors Affecting Viscosity of Ice Cream Mix (*Purnell Fund*)

The objects of this project, which is just being started by H. F. DePew, are to study the effect of varying per cents of milk solids not fat and of butterfat on viscosity; of gelatin on whipping quality of mix and on texture of ice cream; and of varying homogenization pressures on viscosity.

ECONOMIC ENTOMOLOGY

European Corn Borer (*Adams Fund*)

A third season's study of the life history of the European corn borer by the Department of Entomology has corroborated the facts as they appeared to develop in the first and second years. There have been seasonal variations in details of life history, but substantially the findings agree. It has now become possible to point out some apparent relations between mortality of this insect under New Hampshire conditions and the periods at which it reaches maturity.

Frequent conferences have been held with the experts in charge of the European corn borer laboratory maintained by the Bureau of Entomology of the United States Department of Agriculture. The studies under way in that laboratory are largely concerned with Massachusetts conditions.

The studies in New Hampshire are planned to supplement these and to supply information as to details of life history under the conditions prevailing in the more northerly state.

The European corn borer continues to develop two generations under New Hampshire conditions. The species overwinters in the larval stage in the stalks of weeds, in corn stubble, and similar situations. When spring is well under way these larvae transform to pupae. This year the date of first pupation was May 18, as compared with April 28 last year, which, in turn, was to be compared with May 4 of the preceding year. The last larva to enter the pupal stage transformed this year July 13, as compared with July 14 last year. The first adult from the overwintering generation emerged this year June 10, as compared with July 30 last year. These dates are a little later than those for the preceding year.

The eggs laid by these adults constitute the beginning of the first generation of the current year. The first eggs were laid this season June 14, which is five days earlier than last year; and the last eggs were laid August 3, which is eleven days earlier than last year. The first larva hatched June 22, as compared with June 27 last year; and the last larva hatched July 27, as compared with August 24 last year. The larvae of this year reached the several stages a few days earlier than those of last year. Pupation began July 21 this year, as compared with July 26 last year and as compared with July 19 the preceding year. Pupation ended August 27. The first adult emerged August 5, which is four days earlier than the corresponding record for the preceding year. The last adult emerged September 13.

Eggs laid by these adults constitute the second generation of the present year as well as the overwintering generation. Egg-laying began August 9 this year, which is two days earlier than last year and three days earlier than the preceding year. The first larva hatched August 19, which is three days earlier than the first larva of last year or the year before.

In studying the records of three consecutive years it is found that about 60 per cent of the borers exhibit two generations under New Hampshire conditions. A further and still more interesting fact has come to light: namely, that only a small percentage of the second generation of larvae are able to overwinter successfully. Such of these larvae as do survive the winter and pupate successfully the next spring, develop into adults of small size, which appear to be capable of producing only a relatively small number of eggs. Apparently there is a limiting factor here in relation to normal increase of this species under field conditions in New Hampshire. It covers a wide territory; but the intensity of infestation is light. This should not be taken to mean that the insect will continue at a relatively low level of abundance. Such may prove to be the case; but much further information will be required before such a conclusion may be safely drawn. The relatively light intensity of infestation may easily prove to be temporary.

It is planned to continue the studies along the lines already followed and to extend the inquiry as conditions make this possible.

The Stalk Borer

A study of this insect was begun in 1923 by P. R. Lowry, and has been carried forward in further detail the present year. A considerable

number of individuals have now been carried through a complete life history. Hatching of overwintering eggs began May 18 and continued until May 29. The preference of larvae as to food plants was noted. In their early stages they appear to prefer the grasses. This year larvae were observed to pass through eight and nine instars. In the work of last year it was noted that the number of larval instars was apparently at least seven. Pupation began August 4 and continued to August 27. The first adult emerged September 1. Emergence continued through September.

It was found that some females are able to deposit eggs one day after emergence.

Up to the present time the species has been found in twenty-two different host plants under field conditions in New Hampshire.

A study of the parasites of the larva has disclosed a species of *Diptera*, which appears to be rather common; a species of *Hymenoptera*, of which only one specimen has been reared; and a species of thread worm, of which two specimens have been reared.

Black Flies (*Hatch Fund*)

The extensive undertaking of identifying all of the larval collections is nearly completed by the Entomology Department. When this has been finished it will be possible to begin correlating the records showing relative larval abundance, state of stream flow, relative abundance of pupae and adults, and the remaining extensive information contained in the records that have been accumulated under this project. It is hoped that the ecological study thus made possible will be interesting as well as extensive. At least one species of black flies new to science has been found in the collections.

White Pine Weevil (*Purnell Fund*)

Plans for a study of this insect under New Hampshire conditions have been drawn up and approved. Only preliminary work has been accomplished thus far.

FIELD CROPS

Ensilage Variety Tests (*Hatch Fund*)

Nine varieties of ensilage corn were grown on one-third acre plots this year under the direction of F. W. Taylor. The soil was a stony loam and was manured at the rate of twenty loads per acre. No fertilizer was used. The corn was planted with a two-row planter May 19. The plots were cut September 28 and 29, having been frosted on the 23rd. The field data on the several varieties are given in Table II.

Samples of the silage of each of these varieties will be analyzed this winter to determine their content of protein, fat, and carbohydrates.

In an adjoining ten-acre field Giant Russian sunflowers were mixed with Leaming corn in the proportion of one bushel of sunflowers to eight bushels of corn. The yield on this field averaged 19½ tons per acre, parts of the field going as high as 24 tons. The sunflowers increase the tonnage materially but are more costly to harvest. The heavy heads break the stalks over, and the work of loading and putting them through the cutter is increased. We have found no disadvantages in feeding the

TABLE II—*Results of ensilage corn tests*

Variety	Maturity	Average height	Per cent ears	Weight 100 stalks	Yield tons per acre
		Ft.		Lbs.	
Eureka	Silks forming	10	10	220	13.85
Pride of the North	Milk to dough	7½	95	210	9.65
N. H. 500	Glazed	6½	95	140	7.95
Minnesota 13	Milk to dent	6½	45	122	8.69
King of the Earliest	Dough to dent	6½	90	166	8.91
Leaming	Silks to milk	9½	20	178	11.07
Improved Leaming	Silks to milk	9	40	178	11.19
Luce's Favorite	Dough to dent	7	90	158	9.57
Sanford White	Dough to glaze	6½	15	100	7.77

sunflower silage from a milk producing standpoint, and the cattle seem to relish it just as much as the straight corn silage.

Alfalfa Plots (*Hatch Fund*)

From the five acres seeded to Grimm alfalfa in June, 1924, 15.6 tons of hay were cut in 1925. The first cutting was made June 15 and yielded 8.9 tons; the second was July 30 and yielded 4.6 tons; the third was September 5 and yielded 2.1 tons. The half of the field which had been inoculated with soil had about 90 per cent of a perfect stand, while the half on which the seed only was inoculated had about a 60 per cent stand. This half of the field was pulverized with a disk harrow, inoculated with soil and reseeded August 5, 1925.

An adjoining five-acre tract which had been in corn for two seasons was seeded June 3, 1925, with oats as a nurse crop. This piece was limed at the rate of 15 pounds per acre. The oats were cut for hay July 24. The alfalfa was not cut afterwards. The work was in charge of F. W. Taylor.

Effect of Climate on Productiveness (*Hatch Fund*)

In southern New Hampshire potatoes usually degenerate rapidly, owing to the development of leaf-roll, and it is generally considered undesirable to grow the same seed two years in succession. During the year, in continuation of previous work, O. Butler studied at East Kingston, N. H., the effect of maturity of Green Mountain seed and Irish Cobbler seed on the development of leaf-roll and mosaic and on yield as compared with the same stock obtained from the point of origin. The data in Table III show that the yield has been maintained and even improved by early harvesting, and that the per cent and relative distribution of leaf-roll and mosaic have been strikingly affected. In the case of the Green Mountain the 90-day stock obtained from strain H in 1922 has remained free from mosaic as has the original stock; but the 90-day stock obtained from strains H and E in 1923 shows 6.9 and 11.64 per cent mosaic respectively, while the older stocks are free from this malady. Leaf-roll increased with the age of the stock very definitely in the case of the Irish Cobbler, less obviously so in the case of the Green Mountain.

TABLE III—*Effect of maturity of seed on the development of degeneration diseases and productivity of seed stock in southern New Hampshire*

A. Green Mountain

Age of stock	1923 Leaf-roll	1923 Mosaic	1923 Yield per acre	1924 Leaf-roll	1924 Mosaic	1924 Yield per acre
	Per cent	Per cent	Bushels	Per cent	Per cent	Bushels
Direct from grower: Strain H	0.50	0.00	378.50	1.37	0.00	271.7
First grown at East Kingston in 1922: Strain H 90-day	0.30	0.00	359.50	7.27	0.00	286.5
First grown at East Kingston in 1923: Strain H 91-day	....	....	.....	2.10	6.09	392.7
Strain H 103-day	....	....	.....	1.53	0.00	449.5
Strain H 127-day	....	....	.....	2.77	0.00	358.1
Direct from grower: Strain E	0.00	0.00	370.90	0.12	0.17	247.0
First grown at East Kingston in 1923: Strain E 91-day	....	....	.....	0.86	11.64	395.2
Strain E 103-day	....	....	.....	1.18	0.00	368.0

B. Irish Cobblers

Direct from grower: Strain E	0.00	0.00	299.00	0.12	0.00	173.0
First grown at East Kingston in 1923: Strain E 70-day	....	....	.....	0.00	0.00	179.2
Strain E 81-day	....	....	.....	8.50	0.00	204.1
Strain E 90-day	....	....	.....	11.00	0.00	193.8

Spraying Potatoes (*Hatch Fund*)

Continuing previous work, a study was made by O. Butler on the effect of pressure and number of nozzles used on the control of late-blight; but only a slight and irregular infection of the malady had developed in the plots at the time the plants were frosted, and there was not sufficient tuber infection to mark any differences.

An 8–4–50 Bordeaux mixture applied fortnightly was compared with both a 4–4–50 mixture and a 4–4–50 mixture plus molasses applied weekly. A heavy infection of early blight developed and killed the non-sprayed plots early in September, while the sprayed plants remained green until the close of the season. The mixtures used gave approximately the same degree of control of early blight as far as the appearance of the foliage was concerned, but the yields obtained were as follows:

	Bushels per acre
8–4–50 Bordeaux mixture applied every two weeks	347.0
4–4–50 Bordeaux mixture-molasses applied every week	342.4
4–4–50 Bordeaux mixture applied every week	316.3
Non-sprayed plants	270.8

In another experiment hand spraying was compared with hand dusting. An acetate dust containing 4.75 per cent metallic copper was applied every two weeks; a Sanders dust containing 8.5 per cent metallic copper every two weeks on one plot and every week on another; and an 8–4–50 Bordeaux mixture was applied every two weeks. Early blight developed in the field, and on September 5 the plants dusted with acetate of copper were practically dead; the foliage on the plot treated with Sanders dust every two weeks was largely dead, but the plants dusted with Sanders dust weekly, while badly spotted, were still quite green and in very nearly as good condition as those sprayed every two weeks. (See Table IV.)

TABLE IV—*Effect of hand dusting and hand spraying on the yield of potatoes affected with early blight*

Method of treatment	Amount of metallic copper applied per acre	Yield of potatoes	
		Gross	Marketable
	Lbs.	Bus.	Bus.
Acetate copper dust	7.13	195.6	173.6
Sanders dust weekly	39.87	217.3	194.6
Sanders dust fortnightly	18.06	220.6	197.3
Bordeaux mixture 8–4–50	20.00	247.3	227.6

Seed Certification (*Miscellaneous Income Fund*)

One hundred and eight acres were inspected for certification, and 104.5 acres met requirements. The average yield per acre was 323.7 bushels.

In order to obtain information regarding the reliability of the certification records, a plot was established by Dr. Butler at East Kingston in which bushel lots of the certified seed produced by growers in 1923 were planted. The results secured are presented in Table V and show that in general the behavior of the certified seed sold was all that could be desired. The total disease count of the majority of the samples came within the requirements for certification.

TABLE V—*Disease records of certified seed potatoes the year of certification and the year following at a foreign station*

Total disease			Mosaic			Leaf-roll			Yellow dwarf		
Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
4.67	1.91	0.00	4.55	1.18	0.00	2.19	0.73	0.00	0.00	0.00	0.00
Disease records East Kingston, 1924											
16.7	4.28	0.23	2.45	1.06	0.00	16.7	2.98	0.00	1.8	0.24	0.00

Certification records, 1923

Seed Source Comparison Test (*State Fund*)*

In order to give the farmers in every county of the state an opportunity to compare New Hampshire Green Mountain certified seed with certified

*In collaboration with the county agents. The county agents laid out the plots and supervised the planting and harvesting.

seed from other states, seed was supplied by Dr. Butler to all the county agents in sufficient quantity so that plots of upwards of 0.5 acre could be laid out. Seed was from four sources: two in New Hampshire, one in Maine and one in Vermont. The Maine seed was from a productive strain that had been grown by the farmer supplying the stock for more than twenty years; the Vermont seed was from one of the best growers, and was reputed to be not only very free from degeneration diseases but to be especially productive; the New Hampshire seed was obtained from a grower in Coös and Strafford counties respectively. Provision was also made to include the seed used by the farmers on whose farms the plots were established.

The plots were laid out as follows: 1st, 2nd, 4th, 6th, 8th, 10th, 11th rows, northern New Hampshire seed; 3rd row, Vermont; 5th row, Maine; 7th row, southern New Hampshire; 9th row, farmer's own seed. The northern New Hampshire seed was, therefore, used as the comparison strain, and the rows were sufficiently numerous so that the probable error of the mean yield could be calculated and thus a fair idea secured of the probable accuracy of the data. In calculating yields the mean of the two rows of the comparison strain adjoining each of the other strains was used as the basis and taken as 100.

TABLE VI—*Maximum, mean and minimum amount of degeneration diseases found in county demonstration plots in 1924*

Source of seed	Mosaic			Leaf-roll		Yellow dwarf		Spindling sprout	
	Max.	Mean	Min.	Max.*	Mean	Max.*	Mean	Max.	Mean
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Northern N. H.	1.73	0.51	0.00	1.35	0.54	0.00	0.00	0.00	0.00
Vermont	2.12	0.88	0.00	2.38	0.76	0.69	0.13	0.00	0.00
Maine	7.85	3.71	1.16	0.48	0.08	0.00	0.00	0.00	0.00
Southern N. H.	2.41	0.93	0.00	2.14	1.20	1.86	0.49	8.90	1.72
Farmer's own	46.28	8.49	0.11	13.22	3.42	2.44	0.40	0.00	0.00

* Minimum in each case was 0.

The data given are for eight plots in the case of the field inspection and for five plots in the case of the yield data.

In studying the data for the field inspection given in Table VI, it will be noticed that the northern New Hampshire seed compares favorably with that from Maine and Vermont. The Maine seed was quite free from leaf-roll, but was rather high in mosaic. The northern New Hampshire and the Vermont seed had about the same amount of mosaic and leaf-roll, about 0.5 per cent of each in the case of the former, and 0.75 per cent of each in the case of the latter. There was a slight amount of yellow dwarf in the Vermont seed and very nearly 0.5 per cent on the average in the southern New Hampshire seed, and about the same amount in the stock the farmers were themselves growing. The southern New Hampshire seed behaved irregularly. In one plot it showed serious weakness; in another it behaved as well as the best, but on the average it must be admitted that it did not behave so satisfactorily as the seed from the northern part of the state. The farmer's own seed showed considerable differences in behavior in the different plots but on the whole was quite good.

The yields obtained are shown in Table VII.

TABLE VII—*Yield of tests of potato seed*

	Yield per acre in relative numbers		
	Min.	Max.	Mean
Northern New Hampshire seed	100	100	100
Vermont seed	96	114	104.6
Maine seed	92	111	97
Southern New Hampshire seed	77	103	92
Farmer's own seed*	95	107.7	100.4

* Four plots only.

The figures show that the yields of the northern New Hampshire seed, the Vermont and the Maine seed were practically identical. The southern New Hampshire seed, as was to be expected from the disease record, yielded less well than the other seed; the lowest yield occurred in a plot in which 8.9 per cent spindling sprout and 1.06 per cent yellow dwarf were found; and the highest yield in a plot where the plants showed 1.5 per cent mosaic and 2 per cent leaf-roll.

Potash Tests on Potatoes (*Hatch Fund*)

These tests were begun in 1922 by F. W. Taylor and have been continued for four years on quarter-acre plots. Their object was to note the effect on yield of varying amounts of potash applied with fixed amounts of nitrogen and phosphoric acid. Stable manure at the rate of twenty spreader loads per acre was applied to all the plots. The potatoes were planted May 20 and dug October 9. The season was more favorable for potatoes than usual and the yields were above the average. There were practically no diseases except a slight amount of early blight.

Table VIII shows the yields per acre for each of the several treatments for 1922, '23, '24, and '25, together with the average yield for the four seasons.

TABLE VIII—*Effects of varying amounts of potash on potatoes*

Fertilizer grade	Bus., 1922	Bus., 1923	Bus., 1924	Bus., 1925	Av. 4 yrs.
4–8–0	215.1	242.0	206.6	297.6	240.3
4–8–3	215.7	252.5	244.4	303.0	253.9
4–8–4	220.4	256.8	245.8	357.0	270.0
4–8–6	246.6	226.0	248.6	366.6	271.8
4–8–10	222.2	214.5	256.1	356.8	262.4
Check	149.0	192.0	164.0	258.7	190.9

The seed used in the test this year was Green Mountain produced from certified seed in 1924. The fertilizer was applied at the rate of 1,200 pounds per acre of 4–8–0 plus from 96 to 320 pounds of muriate of potash. While the results of these four-year tests are not consistent in every respect, they seem to indicate that one year with another where stable

manure is used on the potato ground, the supplementary fertilizer need not contain more than 4 per cent of potash.

Certified versus Uncertified Seed

Two one-tenth acre plots side by side were planted by F. W. Taylor to certified seed of 1924 and to seed grown from certified seed in 1924, but uncertified.

The comparative yields in bushels per acre of ones, twos, and threes are given below:

	Ones	Twos	Threes	Total
Farm seed	312.8	51.4	3.4	367.6
Certified seed	304.2	57.0	2.6	363.8

The differences in yields are not material. This is in accordance with previous tests here when the season is favorable and disease attacks are slight. On the other hand, in unfavorable seasons when yields are comparatively low, the certified seed proves its merits.

FORESTRY

Forest Plots (*Hatch Fund*)

Measurements are now being made by K. W. Woodward on the following experiments:

(1) Response of white pine when released from shade—15 plots.
(2) Response of white pine to periodic thinning—12 plots.
(3) Growth of exotic species—6 plots.

Some of the plots in the first group have served their usefulness and will be discontinued, but others will be taken on in their place so as to check the results already obtained and get data on species not originally included.

By expansion of the plots on thinning we now have a series running from 20 to 40 years at ten-year intervals so that we will have results for the critical period in pure stands of white pine.

No striking results can be reported for the plantations of exotics, but they are now 12 years old and will be increasingly valuable. New species are to be tried out in the spring.

HORTICULTURE

Fruit Bud Formation (*Adams Fund*)

The usual records of yield and growth have been made in the Woodman Orchard by G. F. Potter and S. W. Wentworth.

In addition, it has been noticed that there are differences in regularity of bearing and that the trees in the different plots are now showing significant differences in vitality. This is indicated, in addition to growth differences, by their ability to resist winter injury and the inroads of parasites such as the European apple canker. It now appears that some of the more important differences between the several plots are in the

present condition of the trees. Some have already declined until unprofitable, and others give promise of good productivity for a considerable period of years.

Seven years' records of yield and growth have been accumulated since the last report was issued on this experiment. Under ordinary circumstances a publication would have been issued at the end of the fifth year. However, during the seasons of 1922–1923, the crop was reduced to practically nothing, owing to the fruit buds being eaten from the trees in winter by ruffed grouse which were driven to this unusual food owing to deep snows and lack of food in the woods.

The average yield in pounds per tree, average twig growth, and average trunk diameter are shown in Table IX. It will be noted that yield in the sod plot is relatively low, the vitality of the trees in the sod plot having been materially reduced; and at present there are only eight trees remaining which are considered to be in normal health.

TABLE IX—*Influence of culture on yield and growth of apple trees*

Plot	Treatment	Average yield pounds per tree, 1919–1925	Average annual twig growth, 1919–1924 (Inches)	Average trunk diameter, 1924 (Inches)
1	Sod	84.7±10.6	7.32	12.3
2	Cultivation alternate years. Cover crop	106.0±8.7	4.75	13.4
3	Cultivation alternate years. Cover crop	149.8±18.7	7.96	14.3
4	Clean cultivation. No cover crop	255.6±21.4	7.63	14.1
5	Clean cultivation plus cover crop	255.4±11.9	7.38	14.6
6	Cultivation and cover crop plus complete fertilizer. (Phosphorus as basic slag)	292.8±17.9	7.63	14.8
7	Cultivation and cover crop plus complete fertilizer	269.0±10.8	7.07	15.0
8	Cultivation and cover crop plus complete fertilizer with extra phosphorus	282.6±14.8	7.57	15.6
9	Cultivation and cover crop plus complete fertilizer with extra nitrogen	356.3±12.9	8.89	15.7
10	Cultivation and cover crop plus complete fertilizer with extra potash	270.8±19.0	8.00	16.0

As a consequence, the determination of average yield in this plot and also in Plots 2 and 3, which are cultivated only every second year, is not an accurate one, the probable error being high in relation to average yield. Cultivation has had a marked effect in maintaining vigor and increasing the yield of the trees, cultivation every second year having produced a yield intermediate between that received from trees standing continuously in sod and that received from trees which are cultivated every year.

The annual yield of about 250 pounds per tree on the cultivated trees is only fair. A yield of two barrels of packed fruit per tree per year

would be profitable under New Hampshire conditions; but because the weight of drops is included in this figure which represents total yield, the packed fruit would be less than what we consider the minimum for a good commercial orchard. The sod trees yielding less than 100 pounds total fruit would not only pay no return on land and investment, but would show a loss on operating expense of the orchard. In considering these yields, however, it must be remembered that the average is reduced by the two years near failure due to birds.

Whereas, during the first ten years of the experiment, fertilizers produced no appreciable increase in yield, it is evident that from the 10th to the 17th year the fertilized trees have borne appreciably more fruit than those cultivated only. The average increase for Plots 6, 7, 8 and 10, which receive complete fertilizer in addition to cultivation, is about 40 pounds of fruit per tree above the yield of trees cultivated only. The increase in yield for Plot 9, which receives additional nitrogen with the complete fertilizer, is approximately 90 pounds of fruit per tree. The value of a bushel of A grade fruit under the market conditions prevailing in New England for the past few years has been approximately eighty cents on the tree. However, not all of this increased yield of fruit would be of A grade or better, and consequently it would probably be more nearly correct to assume that the 40 pounds of fruit has been worth on the tree before harvesting, approximately forty to forty-five cents. The cost of a fertilizer under present market conditions is approximately twenty-five cents per tree, so that during this period the increased yield has been sufficient to pay at least the current cost of the fertilizer. The comparison for Plot 9, which receives additional supplies of nitrogen, is even more favorable if the value of the fruit is assumed to be ninety cents and the cost of the fertilizer thirty-eight cents.

It must be borne in mind, however, that the increased yield during this period is probably due to a considerable extent to larger size of trees due to fertilizer applied during the first ten years of the experiment. The total increase in production for the seventeen years would not be sufficient to pay for the total fertilizer bill plus the compound interest for the years in which no return was received. However, the inventory value of the trees in the fertilized plots based on their present evident ability to remain permanent fruit producers is much greater than the present appraisal value of the trees in the plots which are not fertilized. It is now an open question as to whether or not the trees in the fertilized plots are not worth sufficiently more than the other trees to pay for the first ten years that the fertilizers were applied. If this is true the fertilizer has been used at a profit.

It should be noted that in this experiment there is no possibility of comparing the effect of the different elements because in every case a complete fertilizer is used. The only possibility to make such an observation is to compare Plot 8, which receives additional phosphorus, with Plot 9, which receives additional nitrogen, and Plot 10, which receives additional potash. Within the accuracy with which yield is measured, there are no significant differences in yield between Plots 6, 7, 8 and 10, which received normal amounts of fertilizer or increased phosphate or increased potash. However, in Plot 9, in which the amount of nitrogen is increased, there is a very significant increase in the yield. It may also be stated here that the present condition of the trees in Plot 9 is much the

best in the orchard. There is no evidence that all of the benefits thus far observed are not due to the nitrogen and the nitrogen only. If we could be certain that the increased growth and yield are due to the nitrogen only, we could be certain that the applications of fertilizer have paid commercially because the cost of the nitrogen on Plots 6, 7, 8 and 10 is only about seven cents per tree per year, and on Plot 9 the cost is about twenty and one-half cents per tree per year.

The comparison of average yield per tree for the first ten years and for the 11th to the 17th year inclusive, shown in Table X, indicates that the trees in the sod plot have steadily lost vigor and declined, while those in the plots which receive cultivation or cultivation and cover crop have about maintained their vigor and yield of the first ten years. In those plots receiving complete fertilizer with normal amount of nitrogen, the trees have continued to increase in vigor and yield, while in the plots receiving excessive nitrogen there is an increase in yield of over 50 per cent over that obtained during the first ten years of the experiment.

TABLE X—*Woodman orchard—average yield in pounds per tree*

	Plot 1—sod	Plot 5—cultivation and cover crop	Average Plots 6, 7, 8, 10—cultivation, cover crop and complete fertilizer	Plot 9—cultivation, cover crop, complete fertilizer and extra nitrogen
1909–1918...	135	268.0	226.7	219
1919–1925...	84.7	255.4	278.8	356.3

Relation of Composition of Fruit Spurs to Fruit Bud Formation (*Adams Fund*)

Results of the work on relation of composition of fruit spurs to flower production, which was begun in the season of 1921, have now been published.

The data on the second experiment in this series have now been computed, tabulated and analyzed, and will be ready for publication at an early date. Three types of spurs were sampled at frequent intervals throughout the season as follows: 1. Spurs bearing fruit, from trees which had blossomed fully and which bore a heavy crop of apples. 2. Spurs not bearing fruit, from trees which blossomed heavily but from which every blossom had been removed at blossom time. 3. Spurs not bearing fruit, from trees which blossomed heavily but from which blossoms of every second spur were removed at blossom time.

For the continuation of this work plans have been made to use only non-fruiting spurs in order to eliminate the difficulties due to the influence of the apple on the fruit spur. It has also been decided that a smaller portion of the fruit spur should be used than was formerly sampled. We are interested principally in knowing the chemical environment of the primary meristem at the tip end of the spur, and it is possible or even probable that the inclusion of older wood alters the results somewhat. Samples taken during the summer of 1925 were, therefore, limited to the new growth only, although by this method much greater labor is involved.

To throw the greatest light on this problem samples have been taken from sets of trees under twenty-five different environmental co ditions. With this number of plots it is impossible to follow the composition closely by taking a large number of samples from each plot. Therefore, the sampling was done only on two sampling dates at the portion of the year at which it is believed from previous experience the greatest differences in chemical composition will be found. These plans were consummated during the latter part of the fiscal year ending June 30, 1925, and all the samples were taken during the early part of the following fiscal year. The work is being done by G. F. Potter, S. W. Wentworth, and T. G. Phillips.

Winter Injury (*Adams Fund*)

Three lines of work are being followed by Mr. Potter in this study. In the nursery, trees are being grown upon vegetatively propagated Hibernal roots, this variety having been found in laboratory experiments to be the most resistant to damage by cold in winter. These trees have now finished the second season in the nursery and will be dug during the spring of 1925, when observations can be made upon the relative size of trees as compared to the same varieties grafted on seedling stocks and also on the nature of the union between Baldwin and McIntosh scions and Hibernal roots. After these observations are taken, the trees will be planted out for further test under orchard conditions.

The second phase of the work consists of a detailed study of the histology of winter injury. A considerable number of slides have been stained and examined, but no conclusions as yet have been reached as a result of this study.

In connection with studies of the chemical composition of hardy and non-hardy roots, sixteen additional samples were taken during the present year. In this work an effort is being made to determine whether or not withering of the roots, which is known to materially increase their hardiness, produces a correlated change in the composition of the seedling. Samples of one-year-old apple seedlings, some of which were in turgid condition just as they were taken from moist sand in a cool storage, were compared with samples of similar roots which had been removed from the moist sand and exposed to the air of a dry cellar for 24 hours. From previous experiments it is known that under exactly the same conditions the roots which have been withered will be found to show only half as much injury from freezing as those which are moist and turgid. Whether this increased hardiness is due to or accompanied by a chemical change which can be detected by analysis will be determined. No progress was made in the analysis of the samples previously taken which consist of parts of individual roots known to be relatively hardy or relatively tender when under similar conditions of moisture and storage. It is hoped that during the present fiscal year it will be possible to carry forward analysis of all these samples at the same time.

Storage and Blanching of Celery (*Hatch Fund*)

Changes in the composition of five distinct portions of Golden Self-blanching celery plants were studied by O. H. Pearson during the period of two months while they were stored in an outdoor pit. Methods of analysis now in vogue were found to be entirely inadequate in many respects. Particular difficulty was encountered in the analysis for starch

which is found only in small quantities in the celery plants at this season of the year. It was impossible to obtain constant results with standard methods, the difficulty evidently being due to the fact that the starch grains are imbedded within plastids and are, therefore, not reached by the usual reagents. Various special treatments were tried to render starch available, but no satisfactory method was arrived at.

The results with sugars appear to be most accurate and of greatest value. Reducing sugar is relatively abundant, particularly in the inner leaves and petioles, which are the portions of the plant marketed after storage. There was an increase in the amount of reducing sugar shortly after the plants were placed in the pit, the percentage of this substance in the fresh weight rising from 0.8 to 1.0 during the first two weeks. After this time, however, it remained practically stationary for the next six weeks. The sucrose, on the other hand, increased steadily from the beginning of the storage period until the close on December 8, especially in the stems and the inner petioles. The celery becomes increasingly sweeter and more tender as the storage period advances. In early December the stalks are decidedly sweeter to the taste than in late October. The bettering of the quality is more closely correlated with the gradual increase in sucrose than with the sudden rise in reducing sugar at the outset of the storage period. It appears, therefore, that the sweeter quality of the celery stalks at the end of the storage period must be due to increase in sucrose rather than increase in reducing sugar.

It was thought possible that an accumulation of water soluble pentosans would occur in the tissues during the period that they are exposed to cold weather in the storage pit. This, however, was not found to be the case.

It was not expected that the nitrogen would change, but the analysis showed clearly that the per cent of nitrogen increases materially in the inner portion of the plant. Since it is impossible for much nitrogen to be taken from the soil by the roots under the conditions of the storage, it appears that the source of nitrogen must be the older leaves in the outer portion of the plant which shrivel and dry while the plants are in storage.

An attempt was made to determine whether the glucoside apiin is present in appreciable quantities and whether it is responsible for the characteristic flavor of celery, but it was not possible to correlate the celery flavor with its presence.

Anatomical studies were made to determine the structure of the petioles and the nature of the strings so frequently objectionable. Contrary to the published opinion of previous investigators, who have believed that the strings are formed out of collenchyma tissue which is found just beneath the ribs, our investigations seem to indicate that the strings are composed of relatively hard and lignified xylem cells in the fibro-vascular bundles. Xylem tissue is the only tissue which shows lignification by the phloroglucine—HCl test and by staining with safranine. The very simple test of breaking the stems and extracting the strings indicates that they are more deeply imbedded in the tissue than are the collenchyma cells.

Variety Test of Fruits (*Hatch Fund*)

No important results have been obtained this season in the variety test project in charge of G. F. Potter and S. W. Wentworth. In the commercial markets of the year, the outstanding and significant fact is

the constantly increasing popularity of the McIntosh variety. During the present season, with very heavy supplies of this variety on the New England markets, the demand has on all occasions increased sufficiently to move all of the fruit at relatively satisfactory prices. Accordingly, interest is aroused in the newer seedlings of McIntosh. Late maturing seedlings of McIntosh recommended by the New York Experiment Station are already planted in the test orchard of this Station. A number of seedlings which mature earlier than the parent variety are now available and will be added to the Station list of varieties next season.

A bud sport of the well-known Red Delicious is now being disseminated, and a number of trees of this new strain were planted in the test orchards last spring. It is believed that a late winter apple of high quality which will succeed the McIntosh in the fruit stand trade would be of immense value in this territory. Considerable interest is being shown in the horticultural world in the dark red sports which are now known in a number of our important commercial varieties, including not only the Delicious formerly mentioned but also the Baldwin, Spy, Duchess and Gravenstein. Efforts are being made to obtain propagating wood of all of these sorts for use in our station test orchards. It is of interest to note that the dark red sport of the Baldwin, which is the foremost commercial variety of apple in this country, occurred in Salisbury, N. H.

Pruning Experiment with Apples

The orchard of Northern Spy and McIntosh, in which the different blocks are being trained respectively to the vase, semi-leader and full leader forms, has now passed through its seventh season. A scattering crop of fruit was picked this year from the McIntosh trees, and there are indications that the crop will be heavier another season. The data on growth and pruning of this orchard are given in Table XI.

TABLE XI—*Wood removed and growth under different methods of pruning*

	Vase	Semi-leader	Full leader	Unpruned
Diameter in inches at close of 1924.....	2.57	2.69	2.74	1.70
Inches increase in trunk diameter, 1924..	0.51	0.48	0.51	0.37
Pounds of wood removed in pruning, spring of 1924.....	1.40	1.45	1.09	....
Weight of prunings relative to size of tree	1.40	1.38	1.02	....
Yield per tree in pounds.....	10.08	7.72	5.01	....

The total size of the trees as indicated by trunk diameter appears to be slightly greatest in the full leader trees. As has been stated in previous reports, the unpruned trees in this experiment are unfortunately all situated under soil conditions different from and less favorable than those under which the trees under the three pruning treatments are growing. Consequently the size of these trees is not so great as that of the pruned trees although the fact that pruning reduces total growth is well established by horticultural experimentation. Mr. Potter's pruning during the present season has been slightly less severe upon the full leader than upon the vase form and semi-leader trees. Pruning in the

vase form trees is for the most part only such as is necessary to maintain the different foundation branches in approximately equal and balanced growth. On the semi-leader plot relatively severe pruning is necessary on the central branches in order to reduce their growth and cause greater development of the laterals.

The yield for the present season is probably more closely related to individual differences in the trees than to any effect of the pruning up to date. One of the points of greatest interest will be the proportion of different grades of fruit on the basis of color and quality which may be obtained from trees pruned to different types of head.

Fertility in the Peach Orchard (*Hatch Fund*)

The winter of 1924–1925 being mild, a large number of peach buds survived, and a full crop of peaches was harvested during the summer of 1925. The yields under the different treatments and the present diameter of the trunk in inches are shown in Table XII.

TABLE XII—*Yields and trunk diameters in peach fertility experiment, 1925*

Plot	Treatment per tree	Yield in pounds	Trunk diameter (inches)
1	2 pounds nitrate of soda	118.6±8.2	5.5
2	2 pounds nitrate of soda, 1 pound muriate of potash	176.2±8.2	5.5
3	Check	89.3±4.9	4.7
4	2 pounds nitrate of soda, 3 pounds acid phosphate	93.2±6.3	4.7
5	2 pounds nitrate of soda, 1 pound muriate of potash, 3 pounds acid phosphate	111.9±6.5	5.0
Average 1–2–4–5	Nitrogen alone or in combination	125.0	....
Average 1–4	Nitrogen without potash	110.1	....
Average 2–5	Nitrogen with potash	144.0	....

The results of this experiment are not so conclusive as might be desired because of the relatively small size of the plots and because it is not certain that the different plots are under perfectly similar soil conditions. The treatments are not repeated on different plots, and it is therefore impossible to eliminate the error due to differences in soil.

It may be noted, however, that there is manifestly increased yield on the four fertilized plots as compared to the check. While in peaches the trunk diameter is not closely correlated with total size and growth of the trees, there is a difference in growth in the several plots which is evident to the eye and which is not expressed by the trunk diameter measurements. The check plot and the division rows between the other plots which do not receive the nitrogenous fertilizer are distinctly smaller in total spread of branches than are those which receive the nitrogen. The average increase in yield for the plots which received nitrogen as compared to the check which receives none is approximately 32 pounds per tree. This increased yield due to nitrogen is in substantial agreement with

results which have been published by other experiment stations. It is probable that still greater increases would be obtained from the use of larger applications of this fertilizer.

In two different parts of the experiment, plots which receive muriate of potash show a somewhat higher yield than adjoining plots which are otherwise under similar treatment. Thus, Plot 2, which receives muriate of potash in addition to nitrate of soda, has an average yield of nearly 58 pounds per tree more than Plot 1, which receives nitrate of soda only. This increase is nearly five times the probable error of the difference as calculated from the variations in yield on the individual trees. Similarly, Plot 5 differs from Plot 4 simply by the addition of one pound of muriate of potash per tree. The increased yield in this case is 18.7 ± 9.1 pounds per tree. In this case, the difference is hardly great enough to be considered significant, considering the variation between different trees. On the whole, these results with potash may be considered to be suggestive but by no means conclusive. They are strikingly similar to results published by the Delaware Experiment Station where,—exactly as in this case,—there was an increased yield on the plots receiving potash, although the increase was hardly great enough to be conclusive.

The plots receiving acid phosphate appear to give a decreased yield. Thus, Plot 4 differs from Plot 1 only in that it receives in addition three pounds acid phosphate per tree, yet the yield is some 25 pounds per tree less. Plot 5 differs from Plot 2 merely by the addition of acid phosphate, and the yield in this case is 14 pounds per tree less. However, Plots 4 and 5 are both situated at one side of the field, and Plots 1 and 2 are located at the other. Therefore, the comparison of the respective plots which receive acid phosphate with those which do not receive it, is not believed to be reliable.

Acid Phosphate on Squash (*Hatch Fund*)

During the latter part of May the acid phosphate fertilizer plots previously used for tomatoes were planted to squash by J. R. Hepler. These plots are 20 x 34, and twelve hills of squash were planted on each. They were thinned to three plants per hill, but owing to subsequent attack of fusarium disease the number of plants per hill was not absolutely uniform.

The treatments were as follows:

Treatment 1. Plats 1, 9, 17 and 25—40 tons of manure per acre.
Treatment 2. Plats 2, 10, 18 and 26—20 tons of manure per acre.
Treatment 3. Plats 3, 11, 19 and 27—20 tons of manure per acre and 1,000 pounds of gypsum per acre.
Treatment 4. Plats 4, 12, 20 and 28—20 tons of manure and 1,000 pounds of 16% acid phosphate per acre.
Treatment 5. Plats 5, 13, 21 and 29—20 tons of manure and 500 pounds of acid phosphate—16 per cent—per acre.
Treatment 6. Plats 6, 14, 22 and 30—20 tons of manure and 1,000 pounds of acid phosphate—16 per cent—and 1,000 pounds of muriate of potash per acre.
Treatment 7. Plats 7, 15, 23 and 31—20 tons of manure and 1,000 pounds of muriate of potash per acre.
Treatment 8. Plats 8, 16, 24 and 32—20 tons of manure and 1,500 pounds of acid phosphate—16 per cent—per acre.

Growth measurements were taken on six vines on each plot, one vine per hill being measured once a week.

Table XIII gives the total measurements for twenty-four plants and the comparison with the check plot, No. 2.

The effect of acid phosphate on the early growth of the squash plant is shown by the increases of 70 per cent, 51 per cent and 92 per cent respectively on the acid phosphate plots, 4–5–8, on July 8; July 15 the increases were 65, 46 and 99 per cent respectively over the check treatment; while on July 22 the increases were 75, 61, and 87 per cent for the phosphate plots and 66 per cent for the extra manure plot. With the exception of the measurements on Plot 6 on July 22, the results on Plots 6 and 7 are consistently lower than the check, indicating that a high application of potash salts is injurious to early growth.

TABLE XIII—*Squash growth and field data, 1925*

Treatment number	Total growth in inches of six plants in each treatment				Total weight pounds	Per cent with the check	Average size per squash
	July 1	July 8	July 15	July 22			
1	75 ½	246 ½	1,391	5,868	2,016.7± 82.4	129.5	12.3
2	74 ½	207	1,075	3,533	1,556.4± 77.5	100.0	11.1
3	88 ½	287	1,351	5,343	1,528.2±112.9	98.2	11.3
4	94 ½	353	1,773	6,180	1,688.9± 53.6	108.5	11.6
5	93 ½	313	1,566	5,696	1,792.9±106.0	115.2	13.9
6	70 ½	179	985	3,649	1,670.9± 64.0	107.4	10.8
7	55	130	704	3,194	1,425.3± 34.3	91.6	9.7
8	97 ½	397	2,139	6,615	1,845.6±152.1	118.6	12.5

The differences in yield are not as pronounced for squash as they were for tomatoes. The extra manure plot yielded more than the acid phosphate plots, although acid phosphate uniformly increased the yields. There was some fusarium disease in the plots and probably more on treatments 3–4 and 8 than on the other treatments. When the plants were noticeably affected they were discarded, but the disease was probably not completely eliminated.

The correlation of yield of squash with the early growth July 22 was .239±.088. This correlation is low as compared with tomatoes in 1924, when the correlation was .966±.009 (N. H. Tech. Bull. 28, p. 33).

The yield of squash as influenced by the number of plants per hill is shown in Table XIV.

TABLE XIV—*Yield of squash and number of plants per hill*

	Number hills	Number plants	Number squash	Number squash per hill	Total weight (Pounds)	Average weight per hill (Pounds)	Average weight per plant	Average weight per squash	Yield per acre (Tons)
Three plants per hill	172	516	584	3.4	6,751	39.1	13.0	11.7	15.8
Two plants per hill	101	202	308	3.0	3,522½	34.9	17.4	11.4	14.1
One plant per hill..	43	43	74	1.8	1,039	24.2	24.2	14.1	9.9

Each hill was allowed 54 square feet. The average size of the squash was decidedly larger where there was only one plant per hill. This is a disadvantage because the smaller size squash are preferred on the market.

Permanent Soil Fertility in the Garden (*Hatch Fund*)

In April, 1925, the garden soil fertility plots were planted by Mr. Hepler to spinach. Half of each one-eighth acre plot is limed every second year with 2,000 pounds ground limestone. The yields of spinach on the limed and unlimed portion of each plot, and the total yields are given in Table XV.

That spinach needs heavy fertilization is evident from these results, there being practically no yield in the plots which receive little fertilizer. The results in Plots 3 and 6 indicate that commercial fertilizer may be substituted for stable manure to a considerable extent. The spinach on the limed portion of the plots was much better than on the unlimed portion, the increase being 75.5 per cent as an average for the entire experiment. The increase was greatest in those plots which did not receive manure.

After the spinach was harvested, the plots were planted to Danish Ball Head cabbage without further applications of fertilizer. The yields are given in Table XVI.

While the differences in yield were not so pronounced as with spinach, the value of high fertilization is again apparent. Eight to sixteen tons of manure plus commercial fertilizer is probably the most profitable treatment.

The limed half yielded 16.6 per cent more cabbage than the unlimed. The increase occurred largely in Plots 5 and 7 where neither manure nor commercial fertilizer is used.

Tomato Maturity Project (*Hatch Fund*)

In connection with the experiment on effect of acid phosphate on maturity in tomatoes, it was determined that the larger early yield which results from application of this fertilizer is due to an earlier growth and earlier production of blossom clusters rather than to any hastening of the rate of ripening of individual fruits after the blossoms have set. As a continuation of this work fourteen different varieties and strains of tomatoes were placed under observation by J. R. Hepler to determine whether the differences between the standard early and late sorts are due to earlier growth or more rapid ripening of the fruits. Three strains of Earliana were averaged as early types; John Baer, Stokes' Bonny Best, Chalk's Jewel and the local strain of Bonny Best for the medium early type; two strains of Greater Baltimore, Stone and Burpee's Self-Pruning, for the late type; Dwarf Stone and Dwarf Champion for the dwarf types.

The results in Table XVII show that the earlier varieties grow more rapidly early in the season. The growth on the late varieties occurs so late in the summer that in this climate much of the fruit produced never ripens.

Growth and blossom production are closely correlated in plants of the same variety; the early types produce their flower clusters earlier than the late types.

TABLE XV—*Yield of spinach on garden soil fertility plots*

Plot	Treatment	Limed half	Unlimed half	Total	Per cent of check
1	32 tons manure	551¾	495½	1,049¼	794.8
2	24 tons manure, 150 lbs. tankage, 100 lbs. nitrate of soda, 600 lbs. acid phosphate, 150 lbs. muriate of potash	590¾	501¼	1,092	825.7
3	Green manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 800 lbs. acid phosphate, 300 lbs. muriate of potash	697½	295½	993	751.5
4	16 tons manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 800 lbs. acid phosphate, 300 lbs. muriate of potash	767	386	1,153	873.5
5	Check	131¾	.....	131¾	100.0
6	8 tons manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 800 lbs. acid phosphate, 300 lbs. muriate of potash	604½	264½	869	558.3
7	Green manure	.....	.....	.....	.....
Total		3,343¼	1,944¾	.....	.....

NOTE: Increase of limed over unlimed portion 1398.5 pounds, or 75.5 per cent.

TABLE XVI—*Yield of cabbage on garden soil fertility plots*

Plot	Treatment	Pounds cabbage		Per cent increase limed over unlimed portion	Total pounds cabbage per plot	Yield per plot expressed as per cent of check	Average weight each head	Tons per acre
		Limed	Unlimed					
1	32 tons manure	2,644¼	2,492½	6.1	5,136¾	239.1	6.2	20.5
2	24 tons manure, 150 lbs. tankage, 100 lbs. nitrate of soda, 600 lbs. acid phosphate, 150 lbs. muriate of potash	2,233¾	2,385	−2.3	4,618¾	214.9	5.6	18.5
3	Green manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 500 lbs. acid phosphate, 300 lbs. muriate of potash	1,782¼	1,688½	5.6	3,470¾	161.5	4.1	13.9
4	16 tons manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 500 lbs. acid phosphate, 300 lbs. muriate of potash	2,302¾	1,980¼	16.3	4,283	199.3	5.1	16.9
5	Check	1,482¼	666¼	122.5	2,148½	100.0	3.2	8.6
6	8 tons manure, 250 lbs. tankage, 160 lbs. nitrate of soda, 500 lbs. acid phosphate, 300 lbs. muriate of potash	1,953 ½	1,797	8.7	3,750½	174.5	4.8	15.0
7	Green manure	884	377½	134.1	1,261½	58.7	2.4	4.6
Total		13,282 ¼	11,387	.....	.....	.....	...	....

NOTE: Increase of limed over unlimed portion 1893.25 pounds, or 16.6 per cent.

With medium early varieties like Bonny Best it takes new growth about two weeks to produce blossom clusters, and the fruit on these clusters from five to six weeks to mature.

TABLE XVII—*Relation of yield to growth and cluster production in early and late tomato varieties*

Type	Total growth for six plants, July 9 (Inches)	Total clusters for six plants, July 23	Ounces of ripe fruit for six plants, Sept. 11	Total growth for six plants, July 15 (Inches)	Total clusters for six plants, July 29	Ounces of ripe fruit for six plants, Sept. 18	Total growth for six plants, July 29 (Inches)	Total clusters for six plants, Aug. 18	Ounces of ripe fruit for six plants, Oct. 1
Early	218	54	425	449	88	582	1,280	234	948
Medium	183	36	142	439	65	394	1,513	294	1,246
Late	155	25	59	341	52	163	1,286	245	1,214
Dwarf	60	9	46	137	17	76	468	89	462

While there is a correlation between growth, flower clusters produced and yield of fruit, it is not so close as one would obtain using plants of a single variety only. In order to bring out this relation more closely the inches of growth necessary to produce one blossom cluster and the pounds of fruit ripened from each blossom cluster are given in Table XVIII.

TABLE XVIII—*Growth and yield per plant in early and late tomatoes on the basis of each cluster of flower buds*

Type	For one flower cluster produced July 23		For one flower cluster produced July 29		For one flower cluster produced Aug. 18	
	Average inches total growth, July 9	Average yield in ounces, Sept. 11	Average inches total growth, July 15	Average yield in ounces, Sept. 18	Average inches total growth, July 29	Average yield in ounces, Oct. 1
Early	4.0	7.8	5.1	6.6	5.5	4.1
Medium	5.1	4.3	6.7	6.1	5.2	5.4
Late	6.2	2.4	6.6	3.1	5.3	5.0
Dwarf	6.7	5.0	8.1	4.5	5.3	5.1

It seems that the time of ripening for the early types is shorter than for the late types, since the fruit per cluster ripened on September 11 is 7.8 ounces for the early type, 4.3 ounces for the medium, and 3.0 for the late. The average fruit produced per cluster on the dwarf plants is high because of the small number of clusters. On September 18 the average yield per cluster on the medium varieties had practically caught up to that of the early varieties, the lower yield on that date being due to a smaller number of clusters on July 29. In this climate the early and medium early varieties are generally most profitable because a large proportion of the fruit on late varieties does not ripen. This is shown in Table XIX.

Effect of Fertilizer on Strawberries (*Hatch Fund*)

In previous experiments carried on at this Station nitrate of soda applied to strawberries either during the non-fruiting or the fruiting year has failed to increase the yield and in some cases has decreased it. With nitrate of soda larger leaf area has been obtained, and there has been a

TABLE XIX—*Average early and total yields per plant of tomato varieties at different dates during the season*

Variety	Average yield to Sept. 11 in pounds per plant	Total yield of ripe fruit in pounds per plant	Total yield ripe and green fruit in pounds per plant
Sunny Brook Earliana	5.0	5.9	9.0
Stokes' Earliana	4.9	7.6	12.4
Avon	3.3	4.6	8.0
Stokes' Bonny Best	2.1	4.9	11.1
John Baer	2.0	3.6	10.3
Comet	2.9	6.0	12.7
Chalk's Jewel	1.0	3.2	16.6
Greater Baltimore	.8	2.1	13.4
Stone	.5	1.2	13.5
Burpee's Self-Pruning	.7	2.4	9.3
Dwarf Champion	.7	1.2	5.8
Dwarf Stone	.2	.4	3.9

greater tendency for the plants to wilt during periods of rather low soil moisture content. The tendency for the nitrate-fertilized plants to show a greater amount of wilting than unfertilized plants has been particularly marked just previous to and during the ripening period. It is possible that this greater tendency to wilt may account for the decrease in the crop where nitrate of soda has been used.

In the spring of 1924 a new bed of strawberries was set. This bed was divided into thirty one-twentieth acre plots. Five series of treatments were provided for, each treatment being repeated four times.

A very uniform and excellent stand of plants was produced on all plots during the summer of 1924. Very dry weather occurred during the fall months of 1924, and although no wilting took place it is probable that the bed suffered from lack of moisture during this period. The drought was followed by a very heavy rainfall late in the fall.

In the spring of 1925 observation of a large number of plants by S. W. Wentworth showed that winter injury of the roots and particularly of the crowns had been unusually severe. The pith area of the crowns of approximately 10 per cent of the plants was brown, the only live tissue of the crown being the extreme outer layers of tissue. Blossom buds were not developed on the winter injured plants. The yield on all plots was, therefore, unusually low, but since the injury was apparently uniform throughout the field, its effect upon yield should be uniform for all plots.

At no time during the spring of the fruiting year did the plants suffer from lack of moisture.

As is shown in Table XX, the only treatment which gave a significant increase in yield was where hen manure was applied at the rate of 1,000 pounds per acre.

PLANT PATHOLOGY

Effect of Fungicides and Insecticides on Plants (*Adams Fund*)

Bordeaux mixtures containing from three to five times as much lime as copper sulphate have been recommended for use on plants sensitive

TABLE XX—*Yield in quarts of strawberries per one-twentieth acre plot*

Plot	Rate of fertilizer applications				
	400 pounds nitrate of soda per acre	1000 pounds hen manure per acre	Check No Fertilizer	1000 pounds acid phosphate per acre	300 pounds muriate of potash per acre
1st	101.15	120.	90.5	47.75	56.
2nd	92.	122.	62.5	76.5	80.
3rd	104.	138.5	76.	110.00	101.75
4th	41.	38.25	85.75	77.5	77.25
Average all plots	84.6 ±9.9	104.7 ±15.2	76.2 ±3.3	77.9 ±8.6	78.7 ±6.3

to copper injury such as the apple and peach. In previous experiments O. Butler has found that on plants not sensitive to copper neutral Bordeaux mixtures were less injurious than alkaline mixtures, the standard 4–4–50 Bordeaux mixture for instance; on the other hand, on plants sensitive to copper increasing the alkalinity of the mixture was in general beneficial, more especially in the matter of protection to the older leaves. During the past year he has studied the effect of increasing the lime to five times the copper sulphate present, and has found that injury is very nearly if not entirely prevented. Bordeaux mixtures containing as much lime as copper sulphate will cause injury when a Bordeaux mixture containing five times as much lime as copper sulphate will be without injurious effect.

Toxicity of Fungicides to Parasitic Fungi (*Adams Fund*)

Experiments were made by L. J. Klotz with arsenious oxide, hydrated lime in aqueous suspension, barium tetrapsulphide and ammoniacal silver chloride. Ammoniacal silver chloride was most active of the fungicides used, and was toxic at a strength of .00625 per cent to the spores of *Alternaria solani* which germinate readily in most of the fungicides in common use.

Apple Scab (*Hatch Fund*)

Experience having shown that apples can be adequately protected, even under conditions favorable for scab infection, by spraying at the pre-pink, pink and calyx stages and that the 14-days-after-the-calyx application was not materially beneficial, L. J. Klotz has been investigating the increase in area exposed to infection from one spraying to another. To facilitate calculations the fruit was assumed to be round, and determinations were made on Grimes' Golden, McIntosh, Baldwin, Ben Davis, etc. In general it may be said that the surface area increases on the average from the pre-pink to the pink stage 2.31 mm.; from the pink to the calyx stage 4.3 mm., and from the calyx to 14-days-after-the-calyx stage 94.32 mm. The data obtained, therefore, confirm the results of the spraying experiments; for if infection occurred as readily after the calyx spray as before, the spray interval would be too wide to give protection.

Spraying experiments were continued on the control of scab on McIntosh and Baldwin apples for the purpose of obtaining added information on the relative value of Bordeaux mixture and lime-sulphur solution. The results obtained on McIntosh are given in Table XXI.

TABLE XXI—*Relative value of Bordeaux mixture and lime-sulphur solution for the control of scab*

Time of application and fungicide used				Scab on fruit	Russet
Pre-pink	Pink	Calyx	14 days after calyx		
				Per cent relative	Per cent
None	None	None	None	19.3	....
L. S. 1–50	L. S. 1–50	L. S. 1–50	L. S. 1–50	1.59	4.5
Bor. 2–2–50	Bor. 2–2–50	Bor. 2–2–50	L. S. 1–50	0.76	65.5
Bor. 2–2–50	Bor. 2–2–50	L. S. 1–50	L. S. 1–50	1.34	55.4

It will be noticed that the sprays containing Bordeaux mixture gave better scab control than the schedule in which lime-sulphur solution only was used—results which are in harmony with data previously obtained. If a choice had to be made, therefore, on the basis of scab control one would choose a spray schedule using Bordeaux mixture; but, in practice, one must give consideration to the effect of the spray used on the appearance of the fruit. Bordeaux mixture, even when applied only at the pre-pink and pink sprayings, russeted the fruit quite badly, while, when lime-sulphur solution was used throughout, the russet was very inconspicuous and did not materially destroy the bloom of the fruit. These results also are in accord with previous experiments.*

The experiments on Baldwin showed that lime-sulphur solution could satisfactorily replace Bordeaux mixture, and that under light scab infection a pre-pink and calyx spray, or a pink and calyx spray would give adequate control.

Control of Sooty Mould

Sooty mould did not develop during the season, and the spray schedules ordinarily used for scab produced clean fruit.

Control of Bitter Pit (*State Fund*)

Experiments were begun by Dr. Butler for the purpose of studying the effect of fertilization on the development of bitter-pit, but no marked results were obtained from any of the treatments.

Bean Anthracnose

It is generally considered that anthracnose is freely spread when beans are worked while the plants are wet. We have not found this the case, however. Diseased bean seed was planted by L. J. Klotz at each end of two rows of clean seed. One row was very thoroughly and systematically

* The arsenical used was calcium arsenate. Arsenate of lead in the lime-sulphur solution causes more or less severe russeting.

worked, while the plants were wet, the other only when the plants were dry. The results confirm previous data indicating that working bean plants when they are wet does not materially affect the spread of anthracnose.

	Diseased pods	Diseased bean seeds
	Per cent	Per cent
Plants worked when wet	61.8	17.2
Plants not worked when wet	58.1	11.1

In an experiment on the field control of anthracnose in which 4–4–50 Bordeaux mixture, Sanders' dust—10 per cent metallic copper—and sulphur were used, the protection afforded was too slight to be of any practical importance.

When infected seed was heated for the length of time necessary to destroy the fungus, germination was very seriously reduced. See Table XXII.

TABLE XXII—*Effect of dry heating on the viability of anthracnose and the germinability of affected beans*

Method of treatment	Germination of seed	Diseased plants
	Relative No.	Per cent
Seed not heated	100.0	100
Seed heated 2½ hrs. at 86° C.	53.0	100
Seed heated 2½ hrs. at 86° C. and ½ hr. at 90° C.	59.3	100
Seed treated 2½ hrs. at 86° C. and 1 hr. at 90° C.	9.4	0
Seed treated 2½ hrs. at 86° C. and 2½ hrs. at 90° C.	3.1	0

RURAL ECONOMICS

Cheshire County Survey (*State Fund*)

The study of the balance between farm production and market demands in Cheshire County was completed by H. I. Richards and H. A. Rollins during the year, and has served not only for its original purpose, but as a very valuable experience in formulating future studies. It has been reported upon in detail in Bulletin 217. The Bureau of Agricultural Economics, United States Department of Agriculture, co-operated in this survey.

State-Wide Consumption Survey (*Purnell Fund*)

As a beginning in Rural Economics research work under the Purnell Fund, a preliminary survey is being made by H. C. Woodworth, L. B. Lincoln and H. I. Richards of the consumption of agricultural products, particularly products that might be raised within the state. The object of this is to survey in a general way the situation in the various market centers before attempting to study any one commodity in detail. The

work is being done in co-operation with the Bureau of Agricultural Economics, United States Department of Agriculture.

The retail stores, large hotels and restaurants of the state have been visited, and estimates obtained as to agricultural products, purchases from farmers and products shipped in. The store records are to be summarized into districts so that the general situation will be shown. The hotels in the White Mountains, around the lake regions, near the beaches and the numerous summer camps in different parts of the state will be summarized separately.

In addition carlot shipments in and out of our larger cities are being tabulated and studied. As the freight records cover a period of six years the general situation and trend of wholesale consumption will be available.

In this preliminary work the situation will be studied and discussed as it now exists. Definite recommendations may follow after more detailed study has been made on separate commodities.

Apple Marketing Survey (*Purnell Fund*)

The survey of the commercial apple orchards of the state has been pushed through this fall by G. F. Potter and H. A. Rollins in co-operation with the other New England states and the New England Research Council on Marketing and Food Supply. The results are being tabulated, and will be published in the near future.

RURAL ELECTRICITY

For some years there has been an increasing demand from the American farmer in all sections of the country for electric service. The power utilities companies have responded or refused to respond according as their judgment dictated that the rural extension would be self-sustaining and mutually satisfactory. Their position is somewhat as follows:

Rural line construction may cost from $1,000 to $2,500 per mile, according to conditions.

Rural customers frequently average only 3–5 per mile of line.

Rural consumers have, in the past, averaged too light an electrical load per mile to make it a good financial investment if carried on, on a large scale.

While most extensions already made have been self-sustaining, due to care in selecting the location of lines, a general electrification in agricultural districts might not be successful without adequate investigation to determine more facts on the possible uses of electricity on the farm than are already at hand, and what policies would be best to follow.

We are planning, from the experiment, to secure answers to such questions as the following:

"What amount of current can we expect farmers to use if a great number of operations on the farm use electrical energy?"

"What equipment will it be practical to advise him to install to build up this load which has been proven of economic value to him?"

"What equipment is entirely impractical for his use?"

"At what time in the 24 hours of the day will the peak of the farm or rural load be reached?" or,

"What does the load-curve for 24 hours on a farm fully electrified look like?"

"What is the current consumption for individual machines, operations and processes—what are their 'maximum demands,' etc.?"

"What is the distribution of the use of current throughout the month, season and year for particular operations and the farm as a whole?"

"What are the characteristics of a load from an average dairy farm—fruit farm—poultry farm—general purpose farm—if they use the current to their practical limit?"

From the standpoint of the farmer, his attitude is somewhat as follows:

We are in need of electricity and want to use it.

If the total cost for this service is reasonable, we believe it will be profitable in the saving of labor, hired help, etc.

We would be willing to use as much current and as many devices as are consistent with efficiency and economy, but we do not know now how to do it.

The question of what economies and efficiencies the farmer derives from the individual pieces of equipment used to build up this load is, of course, of first importance. Such questions as the following are of great interest to him:

How will the use of electricity bear on the hired man problem?

How will it affect the costs of production?

Will it be possible to have city conveniences without undue expense or even at a saving over old methods?

Will this help to keep the children on the farm?

How will electricity reduce the drudgery and how much can the farmer afford to pay for conveniences?

What is the value of such equipment from the standpoints of safety, fire hazards, accidents, etc.?

Topics of particular interest to manufacturers of equipment are such as the following:

1. A comparison of electrical operation as against non-electrical with the chief considerations—economy, efficiency and convenience.
2. The determination of how many operations can be electrified.
3. What equipment already available is of practical value?
4. What equipment not now available is there a practical need for?
5. What are the barriers and limiting factors to these electrified processes?

These and many other questions that arise may find a solution, or partial solution, in the results obtained.

In an attempt to get these two largest industries of the country interconnected, the National Electric Light Association met with representatives of the American Society of Agricultural Engineers and American Farm Bureau Federation to discuss the possibilities of solving this economic and engineering problem through co-operative efforts. The result of this meeting was the formation of a national organization known as the Committee on the Relation of Electricity to Agriculture with representatives from each of the following organizations: American Farm Bureau Federation, National Electric Light Association, Power Farming

Association, American Society of Agricultural Engineers, and the U. S. Departments of Agriculture, Commerce, and the Interior.

The National Committee has already organized state committees in fifteen states.

At the suggestion of the National Committee, plans for carrying on experimental work for the New England area were drawn up. The state of New Hampshire was settled upon as being representative, and a state committee, composed of well-known men of the state, was formed. Arrangements were made to have the work carried on by the Station, and active work on the project was started by W. T. Ackerman, March 15, 1925.

The experiment has three objectives:

1. To equip ten selected experimental farms (comprising dairy, fruit, poultry, and general purpose farms) with electrical equipment, to determine what constitutes the maximum amount of electricity that can be economically and efficiently used in farm operations.

2. To investigate the possibilities of using electricity in community enterprises.

3. To make a survey of the present uses of electricity in this state.

The first named objective has received the greatest amount of attention to date, and is one that requires the greatest effort to bring it into operation.

Of the many angles of this question which could be studied, one principal and important one has been singled out: "What are the limits to the use of electricity on farms?" This involves performing every operation with electricity which has any possibility of success and determining its economic value and efficiency.

A canvass of the agricultural sections of the state was necessary to secure first-hand information.

Many of the experiments carried on in other states have involved the construction of a special rural line and the wiring of the consumers' houses on this line preparatory to carrying on the investigations. It seemed in this state that this expense and delay might be avoided by selecting individuals who already had service installed and a reasonable amount of equipment in use.

This supposition was substantiated by observations made during the preliminary survey of the state, and a list of desirable co-operators with electric current available was made from which the ten experimental farms have been selected. A by-product of the survey is a map of the state showing all important physical features and 80 per cent of the rural lines then in existence.

Seven of the ten experimental farms are already well advanced in the process of being equipped. The remaining three are in view, but will not be attached until spring.

It now appears that the dairy farm holds first place in the way of possibilities for electrification; the poultry farm is a close second; and the general farm has a chance to displace one or both of these, but until more definite information is secured is relegated to third place; our fruit farms, if operated solely as such and carrying no stock, appear to have the least possibilities for building up an electrical load. Future developments may change these placings.

SOILS

Soil Fertility Studies (*Hatch and Purnell Funds*)

The question of the best methods of getting old worn-out hay lands into profitable production is one of the most pressing that confronts the Experiment Station. One series of plots for the purpose of observing the effects of different fertilizer treatments and green manures was started at Durham in 1920, and has now been in hay for three years.

With the possibility of a more complete study as the result of the availability of the Purnell Fund, it was decided to start three new experiments, one with grass, one with legumes and one with rotations. As there is little typical land on the College farm, either worn-out or uniform enough for the work, these experiments are to be located in other parts of the state.

About fifty farms in Rockingham County were visited before selecting a field belonging to Mrs. Sarah Whenal, Greenland, N. H., on the Breakfast Hill road. This has been leased for six years with the renewal privilege. The field contains about eight acres in all, seven of which will be used for experimental purposes.

Sixty-three plots for the grass experiment were surveyed, and laid out and sampled for a Truog Test and for a complete chemical analysis by F. S. Prince and T. G. Phillips. Fifty-one of these plots were then plowed and prepared for seeding, the other twelve being left for check plots upon former methods. One-third of the plowed plots were limed at the rate of two tons, and one-third at the rate of four tons per acre. The other part was left unlimed. Twenty-four of the plowed plots were manured. The manure and lime applications will be made but once in a five-year period. Annual top-dressings will be made on certain of the plots with nitrate of soda and acid phosphate with all these combinations. The plots were seeded down in September, and the first cutting of hay will be taken off in 1926.

A portion of the same field will be used for the legume experiment, and eighty plots were laid out, sampled and plowed during October. These plots will be treated and seeded to legumes common in New Hampshire, in 1926.

No field has yet been chosen for the rotation experiment.

On the plots at Durham, this year's results indicate very little difference resulting from fertilizer treatments, except that the averages show a consistently better yield for those receiving some fertilizer in contrast to the non-fertilized plots. There is a slight increase in average yield of plots having nitrate with phosphorus over those having only phosphorus, but not enough to warrant definite conclusions considering the variation in individual plots included in the averages.

Averaged according to green manure treatments for three years, the two series of plots which received three crops of green manure, show consistent increases in yield over the plots which received none or only one such crop. There is also a slight increase in average yield in 1925 for the plots receiving one rather poor green manure crop over the series which received no green manure, but this does not hold true for 1923 and 1924. There is again considerable variation in the yields of individual plots contributing to all these averages.

It seems desirable to continue the Durham plots another year at least without top-dressing to check up further on the residual value of the green manure. Plowing and reseeding the whole area may seem desirable later.

A brief summary of treatments and yields to date on the twentieth-acre plots involved in this project is shown in Table XXIII.

TABLE XXIII—*Treatments and yields in soil fertility plots*

Hay yields in pounds per acre

	1A and 1A′ One green manure crop	1B and 1B′ Three green manure crops	1C and 1C′ Three green manure crops	11A and 11A′ No green manure crops
1923	3,172.0	3,969.5	4,206.2	3,547.8
1924	3,435.4	3,874.6	3,924.8	3,597.0
1925	1,344.9	1,921.6	1,882.2	1,244.8
	2,650.7	3,255.2	3,337.7	2,797.9

Yields by fertilizer treatments

	Series A	Series B	Series C	Series D	Series E
1923	3,638.5	3,631.6	3,993.1	3,819.0	3,537.2
1924	3,836.1	4,027.1	4,026.0	4,202.9	2,447.6
1925	1,735.0	1,500.5	1,492.6	1,759 0	1,509.7
	3,069.9	3,053.1	3,170.6	3,260.3	2,498.2

Treatments (1923) in pounds:

A	B	C	D	E
R. R. Phos....500 Gypsum.....500	500 A. P.	$NaNo^3$.....100 Raw Rock...500 Gypsum.....500	$NaNo^3$..100 A. P....500	Nothing

All plots limed.
In 1924 all plots, except Series E, were top-dressed with nitrate of soda at the rate of 100 pounds per acre.
No top-dressing was done in 1925.
Untreated plots outside the area plowed used as checks yielded at the rate of 290 pounds per acre.

TESTING AND INSPECTION SERVICE

Feeding-stuffs and Fertilizers (*Miscellaneous Income*)

The usual analyses of feeding-stuffs and fertilizers were made for the State Department of Agriculture and the results of these have been published. In addition a number of miscellaneous samples of feeds, fertilizers, limestone and soil, involving about 150 individual determinations, were made. The work was done by T. G. Phillips, T. O. Smith, S. R. Shimer and J. R. Sullivan.

Seed Tests (*Miscellaneous Income*)

During the season 420 samples of seed were handled by M. G. Eastman; of these 350 were official samples for the State Department of Agriculture, and the results of the findings have been published. The seed-testing laboratory has been recently remodeled. An imported Hearson incubator for germinating seeds, a Spencer binocular microscope and a chainometer analytical balance have been installed. The laboratory was placed

on the provisional "certified list" by the Association of Seed Analysts in December, 1924.

Advanced Registry Tests (*Miscellaneous Income*)

Advanced Registry tests were made under the direction of J. M. Fuller, as follows: Yearly—Ayrshires, 16; Guernseys, 81; Holsteins, 55; Jerseys, 49. Total, 201. Short Time—7 seven-day Holsteins; 1 thirty-day Holstein.

White Diarrhea Tests (*Miscellaneous Income*)

Approximately 29,000 blood samples were taken by the Poultry Department from June 1 to Dec. 25, and about 10,000 more are scheduled, in connection with the white diarrhea tests. About seventy flocks are now on the accredited list. The work was in charge of E. M. Gildow and J. Marshall.

FINANCIAL STATEMENT

A Statement of the Sources of Income and Expenditures during the fiscal year 1924–1925 follows:

FINANCIAL REPORT TO THE UNITED STATES GOVERNMENT OF THE HATCH AND ADAMS FUND FOR THE FISCAL YEAR ENDING JUNE 30, 1925

	Hatch Fund	Adams Fund
DR.		
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1925, under acts of Congress approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund)	$15,000.00	$15,000.00
CR.		
By salaries	$10,789.75	$11,630.00
Labor	413.80	899.08
Stationery and office supplies	161.00	37.66
Scientific supplies consumable	115.09	341.58
Feeding-stuffs	.....	384.86
Sundry supplies	121.25	109.89
Fertilizers	134.04	.....
Communication service	304.90	.96
Travel expenses	618.37	42.38
Transportation of things	307.56	121.81
Publications	474.80	(Omit)
Heat, light, water, and power	600.00	.....
Furniture, furnishings, and fixtures	261.00	67.70
Library	458.19	.....
Scientific equipment	3.60	254.38
Livestock	.....	.....
Tools, machinery, and appliances	236.65	414.76
Buildings and land	.....	694.94
Contingent expenses	.....	.....
Balance		
Total	$15,000.00	$15,000.00

SUPPLEMENTARY STATEMENT OF FUNDS RECEIVED FROM OTHER SOURCES THAN THE UNITED STATES FOR THE FISCAL YEAR ENDING JUNE 30, 1925

	State	Hatch sales	Adams sales	Miscellaneous income	Total
CR.					
By salaries	$4,846.69	.....	.....	$7,129.02	$11,975.71
Labor	159.03	$404.43	$ 659.83	3,080.45	4,303.74
Supplies	1,352.47	.....	1,030.34	1,717.12	4,099.93
Travel	256.53	.....	9.17	1,275.66	1,541.36
Capital expenditures	385.28	.....	119.03	1,104.82	1,609.13
Total	$7,000.00	$404.43	$1,818.37	$14,307.07	$23,529.87

PURNELL BILL

An Act

To authorize the more complete endowment of agricultural experiment stations, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the more complete endowment and maintenance of agricultural experiment stations now established, or which may hereafter be established, in accordance with the Act of Congress approved March 2, 1887, there is hereby authorized to be appropriated, in addition to the amounts now received by such agricultural experiment stations, the sum of $20,000 for the fiscal year ending June 30, 1926; $30,000 for the fiscal year ending June 30, 1927; $40,000 for the fiscal year ending June 30, 1928; $50,000 for the fiscal year ending June 30, 1929; $60,000 for the fiscal year ending June 30, 1930; and $60,000 for each fiscal year thereafter, to be paid to each State and Territory; and the Secretary of Agriculture shall include the additional sums above authorized to be appropriated in the annual estimates of the Department of Agriculture, or in a separate estimate, as he may deem best. The funds sppropriated pursuant to this Act shall be applied only to paying the necessary expenses of conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products, and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry; and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life, and for printing and disseminating the results of said researches.

SEC. 2. That the sums hereby authorized to be appropriated to the States and Territories for the further endowment and support of agricultural experiment stations shall be annually paid in equal quarterly payments on the 1st day of January, April, July, and October of each year by the Secretary of the Treasury upon a warrant of the Secretary of Agriculture out of the Treasury of the United States to the treasurer or other officer duly appointed by the governing boards of such agricultural experiment stations to receive the same; and such officers shall be required to report to the Secretary of Agriculture on or before the 1st day of September of each year a detailed statement of the amount so received and of its disbursement on schedules prescribed by the Secretary of Agriculture. The grants of money authorized by this Act are made subject to legislative assent of the several States and Territories to the purpose of said grants:

Provided, That payment of such installments of the appropriation herein authorized to be made as shall become due to any State or Territory before the adjournment of the regular session of the legislature meeting next after the passage of this Act shall be made upon the assent of the governor thereof duly certified to the Secretary of the Treasury

SEC. 3. That if any portion of the moneys received by the designated officer of any State or Territory for the further and more complete endowment, support, and maintenance of agricultural experiment stations as provided in this Act shall by any action or contingency be diminished or lost or be misapplied, it shall be replaced by said State or Territory to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to such State or Territory, and no portion of said moneys exceeding 10 per centum of each annual appropriation shall be applied directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings or to the purchase or rental of land. It shall be the duty of each of the said stations annually, on or before the 1st day of February, to make to the governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures for the fiscal year next preceding, a copy of which report shall be sent to each of the said stations and the Secretary of Agriculture and to the Secretary of the Treasury of the United States.

SEC. 4. That on or before the 1st day of July in each year after the passage of this Act the Secretary of Agriculture shall ascertain and certify to the Secretary of the Treasury as to each State and Territory whether it is complying with the provisions of this Act and is entitled to receive its share of the annual appropriations for agricultural experiment stations under this Act and the amount which thereupon each is entitled, respectively, to receive. If the Secretary of Agriculture shall withhold from any State or Territory a certificate of its appropriation, the facts and reasons therefor shall be reported to the President and the amount involved shall be kept separate in the Treasury until the close of the next Congress in order that the State or Territory may, if it shall so desire, appeal to Congress from the determination of the Secretary of Agriculture. If the next Congress shall not direct such sum to be paid, it shall be covered into the Treasury. The Secretary of Agriculture is hereby charged with the proper administration of this law.

SEC. 5. That the Secretary of Agriculture shall make an annual report to Congress on the receipts and expenditures and work of the agricultural experiment stations in all of the States and Territories, and also whether the appropriation of any State or Territory has been withheld; and if so, the reason therefor.

SEC. 6. That Congress may at any time amend, suspend, or repeal any and all of the provisions of this Act.

Passed the House of Representatives February 10, 1925.

Attest:

WM. TYLER PAGE,
Clerk.

MAY
1962